Back, neck, and shoulder pain in Finnish adolescents: national cross sectional surveys

Paula Hakala, Arja Rimpelä, Jouko J Salminen, Suvi M Virtanen, Matti Rimpelä

Abstract

Objectives To study changes in pain of the back and neck in adolescents between 1985 and 2001 and pain of the neck, shoulder, and lower back between 1991 and 2001.
Design Biennial nationwide postal surveys, 1985-2001, and annual classroom surveys, 1996-2001.
Setting Finland.
Participants 62 677 12, 14, 16, and 18 year olds and 127 217 14-16 year olds.
Main outcome measures Pain in the back and neck, neck and shoulder, or lower back, at least weekly.
Results Prevalence of pain in the back and neck was greater in the 1990s than in the 1980s and increased steadily from 1993 to 1997. Pain of the neck and shoulder and pain of the lower back was much more common in 1999 than in 1991 and in 2001 than in 1999. Pain was more common among girls and older groups: pain of the neck and shoulder affected 24% of girls and 12% of boys in 14 year olds, 38% of girls and 16% of boys in 16 year olds, and 45% of girls and 19% of boys in 18 year olds; pain in the lower back affected 8% of girls and 7% of boys in 14 year olds, 14% of girls and 11% of boys in 16 year olds, and 17% of boys and 13% of girls in 18 year olds.
Conclusion Pain in the neck, shoulder, and lower back is becoming more common in Finnish adolescents. This pain suggests a new disease burden of degenerative musculoskeletal disorders in future adults.

Introduction

Pain in the neck and shoulder and in the back in adolescence has not been considered as a widespread problem, and only a few studies have been published. A survey in the early 1980s found that more than 20% of Finnish 11-17 year olds had back or neck pain.[1] In the 1990s, population surveys confirmed that back pain, particularly in the lower back, was common in children and adolescents.[2–4] In studies with a sample size of at least 300, the lifetime prevalence of back pain in the range 30-51%.[5] A Finnish population survey in 1991 found 15% of 12-18 year olds had pain in the neck-shoulder at least once a week, and 8% had pain in the lower back.[6] Among Finnish 10-12 year olds, about 30% had musculoskeletal pain at least weekly; pain in lower limbs and the neck was most common.[7]

Among adults, back pain can be disabling and lead to economic loss.[8] Most people experience pain of the back, neck, and shoulder at some time, although few have pain over long periods. In Finland, 80% of people aged 30 years and older have experienced some back pain; half these people have had pain more than five times.[9]

Degeneration of the lower lumbar discs has been discovered in 15 year olds; it may be a risk factor for chronic pain of the lower back in early adulthood.[10] Also, in a one year follow up of 10-12 year olds, musculoskeletal pain symptoms, especially neck pain, were common.[7] These two recent longitudinal studies consider the increase in back and neck-shoulder pain in adolescents from a public health point of view. An increase in pain in adolescents suggests more musculoskeletal pain and more disability and economic loss in adulthood.

We studied changes in back and neck-shoulder pain in Finnish adolescents from 1985 to 2001. In these 16 years, the everyday life of adolescents changed substantially, particularly because of their use of new technology.[11] We used two Finnish population surveys: the adolescent health and lifestyle survey, which covers the entire period, and the school health promotion survey, which covers 1996-2001.

Participants and methods

Adolescent health and lifestyle survey

The nationwide adolescent health and lifestyle survey started in 1977.[12] Questionnaires for self completion were sent to nationally representative samples of 12, 14, 16, and 18 year olds biennially in February, with two further attempts to contact those who do not respond. We obtained samples from the population register centre by selecting all Finns born on certain adjacent dates in summer. The survey was approved by the ethics committee of the department of public health of the University of Helsinki. We used data from 1985 to 2001 (table 1). The mean ages of respondents were 12.6, 14.6, 16.6, and 18.6 years. The timing of the study, sampling, and data collection methods were similar throughout the study period, but the questions were different.

The survey asked three questions about back and neck-shoulder pain. In 1985-9 and 1993-7, one question on back-neck pain was used: "Have you had back or neck pain during the past half a year?" The

Tampere School of Public Health, University of Tampere, FIN-33014 Tampere, Finland
Paula Hakala *research fellow*
Arja Rimpelä *professor of community health*
Suvi M Virtanen *senior researcher of Finnish Academy*
Department of Physical and Rehabilitation Medicine, University Hospital of Turku, Box 52, FIN-20520 Turku, Finland
Jouko J Salminen *chief physician*
National Research and Development Centre for Welfare and Health, Box 220, FIN-00531 Helsinki, Finland
Matti Rimpelä *professor*
Correspondence to: P Hakala paula.hakala@hel.fi

bmj.com 2002;325:743

Table 1 Adolescents responding to the two surveys on back, neck, and shoulder pain. Values are numbers (percentages)

	1985	1987	1989	1991	1993	1995	1996	1997	1998	1999	2000	2001	Total
Adolescent health and lifestyle survey, 1985-2001													
Boys	1601/2164 (74)	3859/5078 (76)	1457/2052 (71)	3523/5105 (69)	3799/5427 (70)	3875/5382 (72)	—	3 809/5 685 (67)	—	3 850/5 580 (69)	—	3 268/5 271 (62)	29 041/41 487 (70)
Girls	1752/2037 (86)	4254/4890 (87)	1648/1962 (84)	4111/4894 (84)	4390/5165 (85)	4507/5241 (86)	—	4 581/5 389 (85)	—	4 369/5 264 (83)	—	4 024/5 094 (79)	33 636/40 043 (84)
Total	3353/4191 (80)	8113/10016 (81)	3105/4032 (77)	7634/9914 (77)	8189/10499 (78)	8382/10610 (79)	—	8 390/11 039 (76)	—	8 219/10 814 (76)	—	7 292/10 417 (70)	62 677/81 398 (77)
School health promotion survey, 1996-2001*													
Total	—	—	—	—	—	—	19 995	22 673	20 475	22 764	20 046	21 264	127 217

*In the school health promotion survey, questionnaires were collected in schools. There is no exact record of the number of children who did not respond, but it is about 12%

alternatives answers were (*a*) seldom or not at all, (*b*) about once a month, (*c*) about once a week, and (*d*) almost daily. In the analysis, (*c*) and (*d*) were merged into a "pain at least weekly" category and (*a*) and (*b*) into the contrasting category. "Daily pain" (*d*) was also analysed separately.

In 1991, 1999, and 2001, neck-shoulder and lower back pain was elicited by separate questions: "Have you had neck or shoulder pain during the past half a year?" and, "Have you had low back pain during the past half a year?" The alternatives provided were the same as for back-neck pain, and, in the analysis, the data were merged as before. Depending on age and sex, 2-4% of the data were missing.

School health promotion survey

The school health promotion survey is a classroom survey focusing on adolescent health, health behaviour, and behaviour in school and has been carried out annually in Finland, since 1996. The survey was approved by the ethics committee of Tampere University Hospital. In 1996, 1998, and 2000, students in the eighth and ninth grades of secondary schools (14-16 year olds) participated in the study from Helsinki, southwestern Finland, eastern Finland, central Finland, and Lapland; and in 1997, 1999, and 2001, from western Finland. Only schools that participated in all three years were included: a total of 109 in 1996, 1998, and 2000, and 107 in 1997, 1999, and 2001. The number children who responded is given in table 1. The 12% who did not respond were absent from school on the day of the study. Depending on age and sex, 2-6% of the data were missing. The questions were phrased as in the adolescent health and lifestyle surveys in 1991, 1999, and 2001.

Reliability of information

We selected subsamples from the original adolescent health and lifestyle survey by systematic sampling (selecting every fifth person, after randomising the first) in 1993 (16 year olds), 1995 (16-18 year olds), 1997 (14 year olds), and 2001 (14 year olds). Four to six weeks after receipt of the completed original questionnaires, we sent out identical questionnaires again. We used $\varkappa$ coefficients to measure the reliability between the test and the retest of weekly symptoms. The results for back and neck pain were good (0.48-0.67). For neck-shoulder and lower back pain, $\varkappa$ coefficients were approximately 0.6. We could not expect absolute agreement because the study was done in the past six months.

Statistical analysis

The data for 2001 were divided into five categories according to the return date of the questionnaire. There were no systematic or significant differences in the prevalence of symptoms between the categories in the entire population or by age and sex. Logistic regression analysis was applied to study the association of explanatory variables (year, age, and sex) using SPSS (version 9.0.1).

Results

Adolescent health and lifestyle survey, 1985-2001

Back and neck pain was measured in 1985-9 and 1993-7. Prevalence increased with age and was more common in girls (fig 1).

Mean prevalence of weekly pain in the back and neck was greater in 1993-7 than in 1985-9, and there was a steady increase from 1993 to 1997, in each age and sex group (fig 1). Odds ratios for 14-18 year olds, adjusted for age, in 1989 compared to 1985 were not significantly different (table 2). After 1993 in girls and after 1995 in boys, however, differences were significant and increasing. We found no interaction between age and study year or between sex and study year in logistic regression analyses. In 12 year old girls (fig 1), an increasing trend was observed and the differences between the years were significant ($P<0.001$), but among boys the curve was U shaped (P=0.006). There was a similar increase in the number with pain every day.

Adolescent health and lifestyle survey

Neck-shoulder and lower back pain were measured in 1991, 1999, and 2001. Both symptoms were more common among girls and in older groups (figs 2 and 3).

Among 12-18 year olds, prevalence of neck-shoulder and lower back pain was higher in 1999-2001 than in 1991, with an increasing trend between these years, for most groups (figure 2). Odds ratios, adjusted

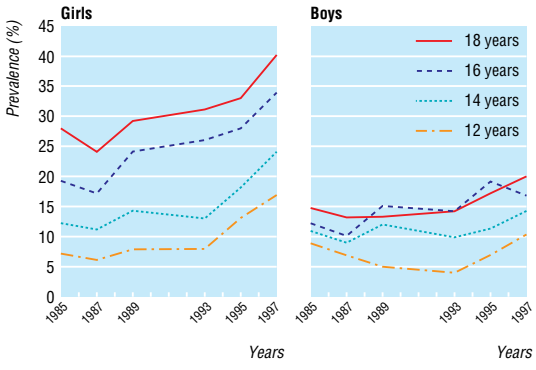

Fig 1 Prevalence of pain of back and neck occurring at least weekly, 1985-97

Table 2 Odds ratio of pain in back and neck in 14-18 year olds, adjusted for age (adolescent health and lifestyle survey)

	1985	1987	1989	1993	1995	1997
Girls	1	0.84 (0.72 to 0.98)	1.14 (0.94 to 1.38)	1.22 (1.05 to 1.42)*	1.49 (1.29 to 1.74)*	1.95 (1.68 to 2.26)*
Boys	1	0.87 (0.71 to 1.06)	1.11 (0.87 to 1.42)	1.01 (0.83 to 1.23)	1.35 (1.11 to 1.64)*	1.50 (1.24 to 1.82)*

* P<0.05.

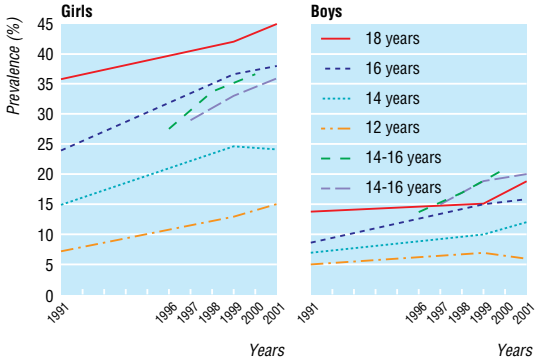

Fig 2 Prevalence of at least weekly neck-shoulder pain in 1991-2001 (adolescent health and lifestyle survey; 12, 14, 16, and 18 year olds groups) and in 1996-2000 and 1997-2001 (school health promotion survey; 14-16 year olds group)

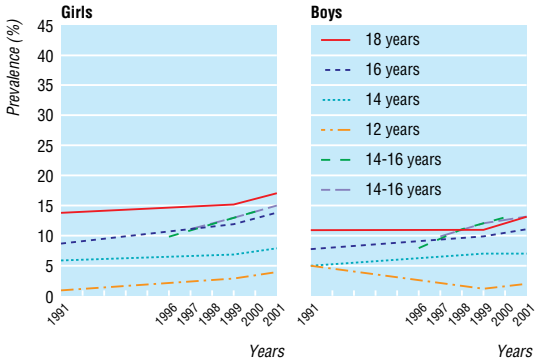

Fig 3 Prevalence of at least weekly lower back pain in 1991-2001 (adolescent health and lifestyle survey; 12, 14, 16, and 18 year olds groups) and in 1996-2000 and 1997-2001 (school health promotion survey; 14-16 year olds group)

for age, were significantly higher in 1999-2001 than in 1991 among both sexes (table 3) with no interaction between age and study year or between sex and study year in logistic regression analyses.

Prevalence of weekly neck-shoulder and lower back pain was much lower in 12 year olds than in older age groups (figs 2 and 3). The differences in prevalence of neck-shoulder pain between the years were significant (P=0.001) for girls, but not for boys (P=0.567). For weekly lower back pain, significant differences were observed for girls (P=0.006) but not for boys (P=0.074). Having daily neck-shoulder or lower back pain showed a similar increase.

The school health promotion survey

Increase in pain of the neck, shoulder, and lower back was significant during 1996-2000 and 1997-2001 (figs 2 and 3 and table 3). We found no interaction between study year and sex in the logistic regression analyses. Prevalence in 14-16 year olds was higher than in the corresponding age groups in the adolescent health and lifestyle survey (figures 2 and 3).

Discussion

Pain of the neck, shoulder, and lower back of adolescents increased in the 1990s, and this trend is continuing. The most sudden increase was at the end of the 1990s. Few trend studies among adolescents have been carried out. Findings from health behaviour in school aged children, however, show that in 11-15 year olds, 20% had weekly backache in 1993-4 and a third in 1997-8.[13 14] The increase in weekly backache among 11, 13, and 15 year olds was similar in most of the participating 24 countries from Europe and Canada. In Finland, no increase in back pain among adults has been observed since 1985,[15] but, in the United Kingdom, a recent survey has suggested an increase.[16]

We found that musculoskeletal pain was more common in girls and in older children. Our results support the evidence that lower back pain is relatively common in adolescence, with greater prevalence in older children.[3 6 17–19] The prevalence of neck-shoulder pain was the same as for other studies at the same ages.[6 20] Our results show that neck-shoulder pain is a common and increasing problem in adolescents, especially girls, suggesting more problems in the young adults of the future.

The two large scale population surveys, representing the whole of Finland, give weight to the results. The studies were carried out independently and data were collected by different methods: postal or classroom surveys. Still, prevalences and trends were similar. Comparability was guaranteed among the years by

Table 3 Odds ratios for pain at least weekly in 14-18 year old Finns

	Adolescent health and lifestyle survey			School health promotion survey*			School health promotion survey*		
	1991	1999	2001	1996	1998	2000	1997	1999	2001
Neck-shoulder pain:									
Girls	1	1.63 (1.48 to 1.80)†	1.72 (1.56 to 1.91)†	1	1.31 (1.25 to 1.38)†	1.50 (1.43 to 1.58)†	1	1.23 (1.17 to 1.29)†	1.36 (1.29 to 1.43)†
Boys	1	1.42 (1.22 to 1.66)†	1.70 (1.46 to 1.99)†	1	1.23 (1.15 to 1.31)†	1.63 (1.53 to 1.74)†	1	1.29 (1.21 to 1.37)†	1.42 (1.33 to 1.51)†
Lower back pain:									
Girls	1	1.26 (1.09 to 1.46)†	1.50 (1.30 to 1.75)†	1	1.14 (1.06 to 1.24)†	1.47 (1.37 to 1.59)†	1	1.19 (1.11 to 1.29)†	1.44 (1.34 to 1.55)†
Boys	1	1.08 (0.91 to 1.28)	1.23 (1.03 to 1.47)†	1	1.24 (1.14 to 1.34)†	1.50 (1.38 to 1.62)†	1	1.27 (1.18 to 1.36)†	1.36 (1.26 to 1.47)†

* Carried out in Helsinki, southwestern Finland, eastern Finland, central Finland, and Lapland in 1996, 1998, and 2000 and western Finland in 1997, 1999, and 2001.
† P<0.05.

What is already known on this topic

Back pain, particularly of the lower back, is common in children and adolescents, and the lifetime prevalence of back pain is in the range 30-51%

Neck-shoulder pain has been little studied in children and adolescents

Degeneration of lower lumbar discs has been observed at the age of 15 and is a significant risk factor for chronic lower back pain in early adulthood

What this study adds

In two independent data sets—one for the lower back and another for neck-shoulder—the prevalence of pain increased in adolescents through the 1990s, particularly in the latter half of the decade

Neck-shoulder pain is common in 12-18 year olds

using identical questions and methods. The overall response rate in the adolescent health and lifestyle survey decreased gradually, to being the lowest in 2001. Selection bias did not become evident, however, with diminishing response rates, and test-retest reliability was good.

Substantial changes to Finnish society and among adolescents may have contributed to the increase in pain. In the 1990s, information technology began to have a tremendous impact on the everyday life of 12-18 year olds. At the end of the 1980s, computer use in schools or at home was still negligible,[11] but in 2001, according to the adolescent health and lifestyle survey, 86% of 12-18 year olds use the internet, 27% daily, and 93% used computer and console games, 54% daily. Musculoskeletal symptoms may be related to risk factors such as repetitive movements, static postures, and static muscular activation patterns in work with computer mice.[21]

Unemployment and cuts in healthcare and school budgets during and after the economic recession of the early 1990s are still being felt today. Biological maturity is reached at a younger age,[22] and other health indicators, in addition to pain of the neck, shoulder, and lower back, have shown adverse development—for example, increasing obesity.[23 24] Children often carry heavy loads during their school day, yet no change in these loads was evident in the 1990s. The reports of health behaviour in schoolchildren from several European countries support our findings,[13 14] suggesting that the factors behind the increase might apply throughout the Western world.

We thank Jukka Jokela, Department of Health Sciences, University of Jyväskylä, and Lasse Pere, School of Public Health, University of Tampere, who were responsible for data processing and initial analyses.

Contributors: AR and MR designed the study. JJS helped reformulate the questions. JJS, MR, and SV provided input throughout the study. PH and AR performed the main analysis, drafted the paper, and coordinated revisions with the other authors. PH and AR are guarantors.

Funding: Ministry of Social Affairs and Health; Medical Research Fund of Tampere University Hospital; Health Promotion Research Programme of the Academy of Finland.

Competing interests: None declared.

1 Salminen JJ. The adolescent back. A field survey of 370 Finnish school children. *Acta Paediatr Scand* 1984;315(suppl):8-122.
2 Olsen TL, Anderson RL, Dearwater SR, Kriska AM, Cauley JA, Aaron DJ, et al. The epidemiology of low-back pain in an adolescent population. *Am J Public Health* 1992;82:606-8.
3 Balagué F, Nordin M, Skovron ML, Dutoit G, Yee A, Waldburger M. Non-specific low back pain among schoolchildren: a field survey with analysis of some associated factors. *J Spinal Disord* 1994;7:374-9.
4 Troussier B, Davoine B, de Gaudemaris R, Fauconnier J, Phélip X. Back pain in schoolchildren: study among 1178 people. *Scand J Rehabil Med* 1994;26:143-6.
5 Balagué F, Troussier B, Salminen JJ. Non-specific pain of the lower back in children and adolescents: risk factors. *Eur Spine J* 1999;8:429-38.
6 Vikat A, Rimpelä M, Salminen JJ, Rimpelä A, Savolainen A, Virtanen SM. Neck or shoulder pain and pain of the lower back among Finnish adolescents. *Scand J Public Health* 2000;28:164-73.
7 Mikkelsson M, Salminen JJ, Kautiainen H. Non-specific musculoskeletal pain in preadolescents: prevalence and 1-year persistence. *Pain* 1997;73:29-35.
8 Maniadakis N, Gray A. The economic burden of back pain in the UK. *Pain* 2000;84:95-103.
9 Mäkelä M, Heliövaara M, Sievers K, Knekt P, Maatela J, Aromaa A. Musculoskeletal disorders as determinants of disability in Finns aged 30 years or more. *J Clin Epidemiol* 1993;6:549-59.
10 Salminen JJ, Erkintalo MO, Pentti J, Oksanen A, Kormano MJ. Recurrent pain of the lower back and early disk degeneration in the young. *Spine* 1999;24:1316-21.
11 Statistics Finland. *On the road to the Finnish information society III*. Helsinki: Helsinki University Press, 2001.
12 Vikat A, Rimpela M, Salminen JJ, Rimpela A, Savolainen A, Virtanen SM. Neck or shoulder pain and low back pain in Finnish adolescents. *Scand J Public Health* 2000;28:164-73.
13 Currie C, Hurrelmann K, Settertobulte W, Smith R, Todd J. Health and health behaviour among young people. Health behaviour in school-aged children: a WHO cross-national study (HBSC) international report, 1997-8:36. www.ruhbc.ed.ac.uk/hbsc/index.html (accessed 2 July 2002).
14 King A, Wold B, Tudor-Smith C, Harel Y. *The health of youth: a cross-national survey*. Geneva: WHO, 1996:68-9. (European series No 69.)
15 Leino PI, Berg MA, Puska P. Is back pain increasing? results from national surveys in Finland during 1978/9-1992. *Scand J Rheumatol* 1994;23:269-76.
16 Palmer KT, Walsh K, Bendall H, Cooper C, Coggon D. Back pain in Britain: comparison of two prevalence surveys at an interval of 10 years. *BMJ* 2000;320:1577-8.
17 Balagué F, Dutoit G, Waldburger M. Pain of the lower back in schoolchildren: an epidemiological study. *Scand J Rehabil Med* 1988;20:175-9.
18 Brattberg G. The incidence of back pain and headache among Swedish school children. *Qual Life Res* 1994;3:27-31S.
19 Fairbank JCT, Pynsent PB, Van Poortvliet JA, Phillips H. Influences of anthropometric factors and joint laxity in the incidence of adolescent back pain. *Spine* 1984;9:461-4.
20 Salminen JJ, Pentti J, Terho P. Pain of the lower back and disability in 14-year-old schoolchildren. *Acta Paediatrica* 1992;81:1035-9.
21 Jensen C, Borg V, Finsen L, Hansen K, Juul-Kristensen B, Christensen H. Job demands, muscle activity and musculoskeletal symptoms in relation to work with the computer mouse. *Scand J Work Environ Health* 1998;24:418-24.
22 Rimpelä M, Rimpelä A, Vikat A, Hermanson E, Kaltiala-Heino R, Kosunen E, et al. Miten nuorten terveys on muuttunut 20 vuoden kuluessa? [How have adolescents' lives changed in 20 years.] *Suomen Lääkärilehti* 1997;52:2705-12.
23 Kautiainen S, Rimpelä A, Vikat A, Virtanen SM. Secular trends in overweight and obesity among Finnish adolescents in 1997-1999. *Int J Obes Relat Metab Disord* 2002;26:544-52.
24 Berntsson L. *Health and well-being of children in the Nordic countries in 1984 and 1996*. Gothenburg: Nordic School of Public Health, 2000. (NHV Report 2000:8.)

(Accepted 5 April 2002)